

## CLAIMS:

- 1 A method of bonding a glass material element and a non-glass material  
element using a glass fixative preform, the method comprising the steps of:  
5 providing a glass preform for bonding the glass material and the non-glass  
material;  
heating the preform to melt the preform; and  
forming a bond with melted glass from the preform, the bond forming  
between the glass material element and the non-glass material element.  
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2. A method as claimed in Claim 1, wherein in the step of heating the preform, a  
source of heat localized to the vicinity of the bond is provided to melt the preform.
3. A method as claimed in Claim 1, wherein in the step of heating the preform,  
15 the non-glass material element generates heat which melts the preform.
4. A method as claimed in Claim 1, wherein in the step of heating the glass  
preform, an induced current flows in the non-glass material element in the region of  
the preform, the induced current generating sufficient heat to melt the preform.  
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5. A method as claimed in Claim 1, wherein in the step of heating the preform,  
an induction heater is positioned in the vicinity of the bond so as to cause induction  
currents to flow in the non-glass material which melt the preform.
- 25 6. A method as claimed in Claim 1, wherein in the step of heating the preform, a  
laser heater is provided to heat the glass preform until the glass preform melts  
sufficiently to form a bond.
7. A method as claimed in wherein the glass material element is a glass fiber,  
30 further including the step of removing non-bonding material from the surface of an  
optical fiber to expose a portion of glass fiber to be bonded.
8. A method as claimed in Claim 1, wherein in the step of forming the bond the  
preform is heated to a temperature in the range 280°C to 480°C.  
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9. A method as claimed in Claim 1, wherein in the step of forming the bond the  
preform is heated to a temperature in the range 320°C to 370°C.
10. A glass fixative for bonding glass elements to non-glass elements, the  
40 fixative having a composition including a lead oxide.

11. A glass fixative as claimed in Claim 10, further including at least one taken from the group including: lead fluoride, and an oxide of: niobium, copper, bismuth, iron, zinc, titanium, aluminum, boron, silicon, and calcium.
- 5 12. A glass fixative as claimed in Claim 10, wherein the glass fixative has a composition including lead fluoride and an oxide of each of the following: lead, niobium, copper, bismuth, iron, zinc, titanium, aluminum, boron, silicon, and calcium.
- 10 13. A glass fixative as claimed in Claim 10, wherein the glass fixative composition includes the following:  $\text{PbO}$ ;  $\text{PbF}_2$ ;  $\text{Nb}_2\text{O}_5$ ;  $\text{CuO}$ ;  $\text{Bi}_2\text{O}_3$ ;  $\text{Fe}_2\text{O}_3$ ;  $\text{ZnO}$ ;  $\text{TiO}_2$ ;  $\text{Al}_2\text{O}_3$ ;  $\text{B}_2\text{O}_3$ ;  $\text{SiO}_2$ ; and  $\text{CaO}$ .
- 15 14. A glass fixative as claimed in claim 10, wherein the glass fixative composition includes the following constituents in the following proportions:  
 $\text{PbO}$  60 %wt to 65%wt;  $\text{PbF}_2$  2%wt to 5%wt;  $\text{Nb}_2\text{O}_5$  2%wt to 5%wt;  $\text{CuO}$  0.5 %wt to 1.5%wt;  $\text{Bi}_2\text{O}_3$  6%wt to 7%wt;  $\text{Fe}_2\text{O}_3$  2%wt to 3%wt;  $\text{ZnO}$  2%wt to 3%wt;  $\text{TiO}_2$  5%wt to 7 %wt;  $\text{Al}_2\text{O}_3$  0.1 %wt to 0.3%wt;  $\text{B}_2\text{O}_3$  2%wt to 3%wt;  $\text{SiO}_2$  0.1%wt to 0.4%wt; and  $\text{CaO}$  1 to 1.5 %wt.
- 20 15. A glass fixative as claimed in Claim 10, wherein the glass fixative has a melting point less than 500°C.
- 25 16. A glass fixative as claimed in Claim 10, wherein the glass fixative has a melting point less than 480 °C.
- 30 17. A glass fixative as claimed in Claim 10, wherein the glass fixative has a melting point between 280°C and 410°C.
18. A glass fixative as claimed in Claim 10, wherein the fixative has a softening point around 320°C to 370°C.
- 35 19. A glass fixative as claimed in Claim 10, wherein the fixative has a transition temperature between 280°C and 300°C.
20. A glass fixative as claimed in Claim 10, wherein the fixative has a thermal coefficient of expansion of 6.5 to 8.5 p.p.m./°C.

21. A fixative preform for bonding a glass material element to a non-glass material element, the preform having a composition including lead oxide.

5 22. A fixative preform as claimed in Claim 21, wherein the fixative perform further includes at least one taken from the group including: lead fluoride, and at least one oxide of: niobium, copper, bismuth, iron, zinc, titanium, aluminum, boron, silicon, and calcium.

10 23. A fixative preform as claimed in Claim 21, wherein the fixative perform composition includes the following:  $\text{PbO}$ ;  $\text{PbF}_2$ ;  $\text{Nb}_2\text{O}_5$ ;  $\text{CuO}$ ;  $\text{Bi}_2\text{O}_3$ ;  $\text{Fe}_2\text{O}_3$ ;  $\text{ZnO}$ ;  $\text{TiO}_2$ ;  $\text{Al}_2\text{O}_3$ ;  $\text{B}_2\text{O}_3$ ;  $\text{SiO}_2$ ; and  $\text{CaO}$ .

15 24. A fixative preform as claimed in Claim 21, wherein the fixative perform composition includes the following constituents in the following proportions:  
 $\text{PbO}$  60 %wt to 65%wt;  $\text{PbF}_2$  2%wt to 5%wt;  $\text{Nb}_2\text{O}_5$  2%wt to 5%wt;  $\text{CuO}$  0.5 %wt to 1.5%wt;  $\text{Bi}_2\text{O}_3$  6%wt to 7%wt;  $\text{Fe}_2\text{O}_3$  2%wt to 3%wt;  $\text{ZnO}$  2%wt to 3%wt;  $\text{TiO}_2$  5%wt to 7 %wt;  $\text{Al}_2\text{O}_3$  0.1 %wt to 0.3%wt;  $\text{B}_2\text{O}_3$  2%wt to 3%wt;  $\text{SiO}_2$  0.1%wt to 0.4%wt;  $\text{CaO}$  1 to 1.5 %wt.

20 25. A fixative preform as claimed in Claim 21, wherein the preform bonds an optical fiber to a metallic element.

26. A fixative preform as claimed in Claim 21, further including at least one substance taken from the group including: nickel, cobalt, kovar or magnetite.

25 27. A fixative preform as claimed in Claim 21, further including at least one substance taken from the group including: carbon black, graphite, and black metallic oxides.

30 28. A glass material bond formed between a glass material element and a non-glass material element with a glass fixative.

29. A bond as claimed in Claim 28, wherein the glass material element is an optical fiber.

35 30. A bond as claimed in Claim 28, wherein the non-glass material element has a metallic characteristic.

40 31. A bond as claimed in Claim 28, wherein the non-glass material element has a ferromagnetic characteristic.

32. A bond as claimed in Claim 28, wherein the non-glass material element has a ferrimagnetic characteristic.
- 5 33. A bond as claimed in Claim 28, wherein the glass fixative includes a lead oxide.
34. A bond as claimed in Claim 28, wherein the glass fixative further includes at least one taken from the group including: lead fluoride, and at least one oxide of:  
10 niobium, copper, bismuth, iron, zinc, titanium, aluminum, boron, silicon, and calcium.
35. A bond as claimed in Claim 28, wherein the glass fixative composition includes the following: PbO; PbF<sub>2</sub>; Nb<sub>2</sub>O<sub>5</sub>; CuO; Bi<sub>2</sub>O<sub>3</sub>; Fe<sub>2</sub>O<sub>3</sub>; ZnO; TiO<sub>2</sub>; Al<sub>2</sub>O<sub>3</sub>; B<sub>2</sub>O<sub>3</sub>; SiO<sub>2</sub>; and CaO.  
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36. A bond as claimed in Claim 28, wherein the glass fixative composition includes the following constituents in the following proportions:  
PbO 60 %wt to 65%wt; PbF<sub>2</sub> 2%wt to 5%wt; Nb<sub>2</sub>O<sub>5</sub> 2%wt to 5%wt; CuO 0.5 %wt to 1.5%wt; Bi<sub>2</sub>O<sub>3</sub> 6%wt to 7%wt; Fe<sub>2</sub>O<sub>3</sub> 2%wt to 3%wt; ZnO 2%wt to 3%wt; TiO<sub>2</sub> 5%wt  
20 to 7 %wt; Al<sub>2</sub>O<sub>3</sub> 0.1 %wt to 0.3%wt; B<sub>2</sub>O<sub>3</sub> 2%wt to 3%wt; SiO<sub>2</sub> 0.1%wt to 0.4%wt; CaO 1 to 1.5 %wt.
37. A bond as claimed in Claim 26, wherein the bond is hermetic.
- 25 38. An optical component containing at least one glass bond.